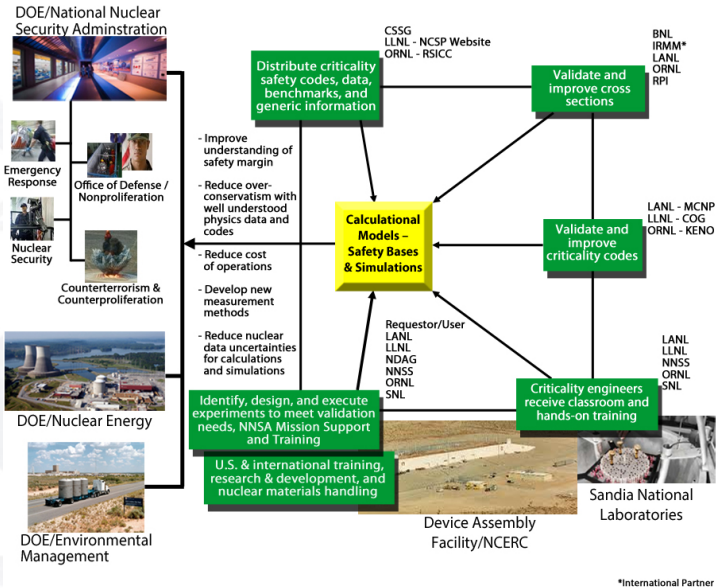
The Mission and Vision

of the
United States Department of Energy
Nuclear Criticality Safety Program

for the
Fiscal Years
2014-2023

National Nuclear Security Administration

The Nuclear Criticality Safety Program Infrastructure Supports Safe and Efficient Fissionable Material Operations DOE-Wide



*International Partner

The Integrated Nuclear Criticality Safety Program

The Department of Energy (DOE) Nuclear Criticality Safety Program (NCSP) is chartered with maintaining the technical infrastructure necessary to ensure safe, efficient operations from a criticality safety perspective. The NCSP and its initiatives have been planned and executed annually in a series of updates to a rolling Five-Year Plan. The Mission and Vision for the NCSP for the next five to ten years facilitates development of a coherent, integrated implementation plan. The Five-Year Execution Plan has been the plan to achieve the five-year vision of the NCSP. As such, revised editions of the Five-Year Plan will continue to be a roadmap to achieving the NCSP described in this Mission and Vision. Five years have passed since the original Fiscal Year 2009 – 2018 Mission and Vision was published. Every five years the Mission and Vision will be revisited and the current ten-year goals and attributes revised to reflect progress during the previous five years. This document will provide the planning basis for all funding and initiatives undertaken by the NCSP. It also defines the values and operating culture of the NCSP.

Nothing is more fundamental to operations with fissionable material than criticality safety. Ensuring that a criticality accident never happens again in a DOE facility is one key facet of the DOE mission supporting the national security and energy needs of the United States. It is with this ultimate goal in mind that this revision of the Mission and Vision for the NCSP is dedicated and approved.

Approved:

October 2013

Dr. Jerry N. McKamy, Director
Office of Environment, Safety and Health, NA-00-10
National Nuclear Security Administration

MISSION

The NCSP mission is to provide **sustainable expert** leadership, direction, and the technical infrastructure necessary to develop, maintain, and disseminate the essential technical tools, training, and data required to support **safe, efficient** fissionable material **operations** within the DOE.

VISION

The NCSP will be a **continually improving, adaptable,** and **transparent** program that **communicates** and **collaborates** globally to incorporate technology, practices, and programs to be **responsive** to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.

VALUES

- **Continual Improvement** – The NCSP assesses its products and processes.
- **Adaptability –** The NCSP encourages innovation.
- **Transparency** – The NCSP discloses its plans, processes, and accomplishments.
- **Communication** – The NCSP dialogues with its stakeholders.
- **Collaboration** – The NCSP engages national and international resources.
- **Responsiveness** – The NCSP responds to the needs of its DOE stakeholders.
- **Sustainability** – The NCSP prepares the next generation of technical leaders.
- **Expertise** – The NCSP involves world-class criticality safety experts.
- **Safety** – The NCSP resolves any threat to criticality safety.
- **Efficiency** – The NCSP tailors solutions to maximize efficiency.
- **Operations** – The NCSP adopts DOE missions and goals as its own.

STRATEGY

The NCSP Mission and Vision will be achieved by identifying and accomplishing a set of five-year programmatic goals in five broad technical program elements that support identified ten-year goals. The yearly implementation plans to accomplish these goals will be developed with the advice and assistance of **experts** appointed by the NCSP manager or working under charters approved by the NCSP manager. The five technical program elements are:

- Analytical Methods
- Information Preservation and Dissemination
- Integral Experiments
- Nuclear Data
- Training and Education

The following sections identify the mission, vision, strategy, and goals for each of these elements as related to the overall mission and vision of the NCSP. Each section contains a list of specific goals to be attained by the end of Fiscal Year 2023. Detailed lists of attributes (a quality or characteristic; a distinctive feature), and five- and ten-year goals for each element have been developed to support the NCSP Vision and are detailed within each program element.

MID-TERM ASSESSMENT

The purpose of this mid-term review of the first NCSP Mission and Vision document for Fiscal Years 2009-2018 is to assess progress in meeting the goals contained in the first document and to provide a road map for **continuing** to **improve** the criticality safety infrastructure necessary to ensure **safe**, **efficient operations** from a criticality safety perspective. Many of the goals in the first Mission and Vision document have been met and each program element will highlight some of the accomplishments within each program element. Some noteworthy accomplishments during the last five years include the start-up of all four critical assemblies in the new National Criticality Experiments Research Center (NCERC) in Nevada; the restart of a water moderated critical experiments capability at Sandia National Laboratories (SNL), Albuquerque; and the initiation of new hands-on training courses at Los Alamos National Laboratory (LANL), NCERC, and SNL for nuclear criticality safety practitioners, managers responsible for criticality safety, and nuclear material handlers. This new Mission and Vision document for Fiscal Years 2014-2023 is organized differently from the last document in that each program element section flows from Mission; Vision; Attributes of a Robust Program Element; to Five Year, Ten Year, and Stretch Goals that if met will help sustain the attributes of a robust program. Furthermore, the Attributes and Goals tables are color-coded to depict a consensus of technical and budget priorities. As before, future, revised versions of this document will **continue** to provide the foundation for the NCSP Five-Year planning process.

Please note that the original Appendix A section is being preserved in this document for archival and future out-year comparison purposes. New Goals and Attributes tables are provided in the main body of this document within each program element.

MISSION

The Analytical Methods (AM) program element provides for the development and maintenance of state-of-the-art analytical capabilities for the processing of nuclear data from the Evaluated Nuclear Data File (ENDF) and the radiation transport analysis capabilities needed to predict system k-effective values. An essential aspect of the AM capability is the human *expertise* required to develop the analytical software, provide software configuration control, and train and assist the user community.

AM Vision

The AM element will **sustain** state-of-the-art radiation transport modeling capabilities and the **expertise** necessary to develop, maintain and disseminate analytical tools and data libraries in a manner that is **responsive** to the needs of those responsible for developing, implementing, and maintaining criticality safety.

AM Strategy

The following strategy has been developed to direct the AM element towards achieving its vision. The AM element will:

- Actively engage the criticality safety practitioners to identify their analytical methods needs through various means of *communication* and develop and implement capabilities to meet those needs.
- Provide and support radiation transport codes and tools containing rigorous physics models, *efficient* solution algorithms, sophisticated and user-friendly modeling capabilities, comprehensive outputs to facilitate user understanding, and methods to perform sensitivity/uncertainty analyses.
- Provide and support data processing codes and tools containing rigorous physics models to produce data libraries required by the transport codes from cross-section evaluations.
- Provide products that are developed and maintained in accordance with modern software quality assurance practices and are *adaptable* to meet changing criticality safety user needs and computing environments.
- Support criticality safety users through various mechanisms including newsletters, users forums, phone and e-mail consultation, and by utilizing a well-defined mechanism for timely distribution of software and data libraries.
- *Sustain* the NCSP analytical capabilities and *expertise* through *continual improvement* of methods and mentoring of the next generation of experts.

AM Technical Gap

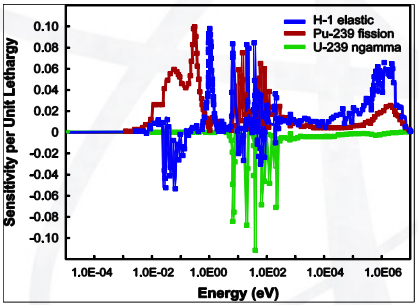
Most of the previous 5-year goals were partially met and are ongoing. Previous goals which were not completed related to real-time analysis of accidents, extension of covariance data, SQA for the processing codes, and linkage of transport codes to CAD. Two goals related to automation of CSE evaluations, data validation and data adjustment were not completed and will not be carried forward in the same form. Two tasks related to ARH-600 were incomplete but will be transferred to the IP&D program element.

AM Attributes and Goals

The AM program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
	Medium Priority
	Low Priority
	S T R E T C H



Sample TSUNAMI Output

Analytical Methods - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel:		Budget Priority	
		Technical Priority	
Cross-section processing developers	Develop and implement succession plans to maintain cross-section processing expertise		
Radiation transport developers	Develop and implement succession plans to maintain radiation transport expertise		
Processing codes and data libraries:		Budget Priority	
		Technical Priority	
Ability to process o Input evaluations in "standard" formats from all international compilations o Reaction cross section/energy/angle o Covariances (reaction/energy/angle)	Develop and maintain more than one independent cross-section processing code system		
	Update processing codes to process new, modern ENDF/B data format		
	Process new covariance evaluations for thermal scattering law data, collision kinematics, fission energy distributions		
Ability to create code dependent libraries o Continuous-energy o Multi-group	Produce continuous-energy, multi-group, and covariance data libraries for use in radiation transport code systems		
Software Quality Assurance (SQA) of processing codes and libraries	Develop and maintain processing software and data libraries under SQA		
	Develop and utilize comprehensive verification/validation suite to allow cross-code comparison of processing results from ENDF formats		
Computational o Multi-platform o Multiple Operating systems, compilers o Adaptable, sustainable (languages, etc.)	Deploy cross-section processing code systems for operation on multiple computing platforms and operating systems		

Analytical Methods - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Radiation transport codes:		Budget Priority	
		Technical Priority	
Solution method ○ Monte Carlo ○ Deterministic ○ Coupled Monte Carlo-Deterministic ○ Solution Efficiency	Develop and maintain more than one independent radiation transport code system		
	Develop and maintain coupled Monte Carlo-Deterministic capabilities to enable automated variance reduction capabilities		
	Develop and maintain modern source convergence and variance reduction methods		
Geometry ○ 1D → generalized 3D ○ CAD/CAE interface ○ Time dependence (e.g., Godiva ringing)	Provide and maintain radiation transport software with geometry modeling capabilities (1D to 3D) needed to support NCS analyses		
	Couple modern NCS radiation transport software with CAD/CAE packages		
	Develop and maintain time-dependent geometry modeling capability		
Physics ○ Coupled neutron, photon ○ Eigenvalue/fixed source ○ Forward and adjoint ○ Time-dependent ○ Continuous-energy ○ Fine group, problem-dependent multigroup ○ Subcritical techniques ○ Depletion capability ○ Temperature dependence and feedback	Provide and maintain radiation transport software with the following capabilities to support NCS analyses: ○ Coupled neutron, photon transport ○ Eigenvalue/fixed source solution ○ Forward and adjoint solution ○ Continuous-energy and multi-group solution		
	Develop and deploy time-dependent radiation transport accident analysis capabilities		
	Develop and maintain NCS radiation transport software with temperature feedback		

Analytical Methods - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Radiation transport codes (cont'd):		Budget Priority	
		Technical Priority	
Ease of Use o Documentation, including limited online help o Graphical User Interface o Interoperability o Materials preprocessing	Develop and maintain the following capabilities: o Documentation, including limited online help o Graphical User Interface o Interoperability o Materials preprocessing		
	Provide regular training courses each year on use of NCS software		
Radiation transport software with modern output and modularity to facilitate NCS analyses	Develop and maintain NCS radiation transport software with the following capabilities: o Ability to link to other physics codes o Detailed physics edits, including detectors o Modern markup language (e.g., HTML) o Graphical displays o Flux, reaction rate edits o Generic multi-physics output (e.g., ABACUS)		
Software Quality Assurance of transport codes	Develop and maintain radiation transport software and data libraries under SQA		
Computational o Multi-platform o Multiple Operating systems, compilers o Adaptable, sustainable (languages, etc.)	Deploy radiation transport systems for operation on multiple computing platforms and operating systems		

Analytical Methods - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Sensitivity/uncertainty (S/U) methods:		Budget Priority	
		Technical Priority	
Sensitivity analysis capabilities o Sensitivity profiles o Similarity assessment o Covariance data (differential, integral, computational)	Develop and maintain more than one independent S/U analysis software package		
	Develop and deploy methods to provide integral experiment correlation data		
	Provide correlation data for integral benchmark experiments		
Data Adjustment	Develop and maintain S/U data adjustment capabilities to support uncertainty analysis and bias quantification		
Validation	Develop and maintain S/U capabilities to facilitate quantitative NCS validation analyses [e.g., similarity assessment, area of applicability determination, upper subcritical limit (USL) determination, etc.]		
Software quality assurance of sensitivity/uncertainty codes	Develop and maintain radiation transport software and data libraries under SQA		
Accident analysis:		Budget Priority	
		Technical Priority	
Field-deployable emergency response methods on portable, handheld platform	Develop and maintain modern, accident analysis capability (SlideRule)		
3D accident analysis capability	Develop and deploy time-dependent multi-physics capabilities: o neutron transport o temperature feedback o hydrodynamics o time-dependent geometry o fluid-flow		

MISSION

(INCLUDES ICSBEP)

The Information Preservation and Dissemination (IP&D) program element preserves primary documentation supporting criticality safety and makes this information available for the benefit of the technical community including international partners (e.g., AWE, CEA and OECD). The NCSP internet website (http://ncsp.llnl.gov) is the central focal point for access to criticality safety information collected under the NCSP and the gateway to a comprehensive set of hyperlinks to other sites containing criticality safety information/resources. IP&D includes documenting and preserving criticality safety benchmarks via the International Criticality Safety Benchmark Evaluation Project (ICSBEP).

IP&D Vision

The IP&D element will identify, preserve, and disseminate selected technical, programmatic, and operational information that enables those responsible for criticality safety to **sustain,** enhance, and **continually improve** performance in support of **safe, efficient** fissionable material **operations**.

IP&D Strategy

The following strategy has been developed to direct the IP&D element towards achieving its vision. The IP&D element will:

- Establish a structured approach to using expert groups and individuals who will assist in identifying and selecting existing sources of organized information and other types of technical, programmatic, and operational information for preservation.
- Establish easily accessible repositories (unclassified and classified) that can be *sustained* to provide for preservation and digital dissemination of the selected information.

IP&D Technical Gap

The majority of the previous 5-year goals were partially met and are ongoing. Many of the previous goals were regrouped and combined [i.e., previous goals combined: Implement data calls for available material; Provide processes for evaluating available material for IP&D value; Archive and disseminate training and operational videos (historical and current); Preserve unclassified topical references (waste drums, vault storage, onsite and offsite transport, criticality alarm placement, D&D, etc.)] to eliminate now identified redundancies or revised to be more specific, in order to improve process and effectiveness. Goals not met [i.e., Develop a repository for all evaluations/reports associated with criticality safety from this point forward; Distribute approved criticality safety program description documents; Develop a process for keeping the Criticality Safety Coordinating Team informed about emerging regulatory actions, impacts and initiatives (DOE letters to contractors)] were removed due to unforeseen impracticalities, and are being managed under different auspices outside of the NCSP. Removal of these goals did not and do not have a negative impact on the IP&D Mission or Vision.

IP&D Attributes and Goals

The IP&D program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
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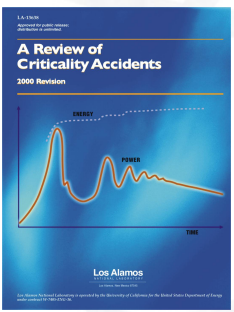
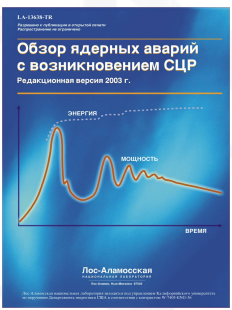
	Low Priority
	S T R E T C H





U.S./Russian Collaboration on Preservation of Criticality Accident Information

Information Preservation and Dissemination - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel/Facilities:		Budget Priority Technical Priority	
Maintain/develop unclassified and classified web-based repositories, with controlled access as needed for important data for criticality safety. Examples include, but are not limited to: o ICSBEP Benchmarks o Classified Benchmarks o Critical Experiment Logbooks o Electronic handbooks and relevant criticality safety standards and data o Operational experience and Training Videos o Criticality Safety Professional Phonebook	Implement and maintain periodic data call for available material: o Provide processes for evaluating available material for IP&D value o Archive and disseminate training and operational videos (historical and current) o Preserve unclassified/classified topical references (e.g., waste drums, vault storage, onsite/offsite transport, criticality alarm placement, D&D)		
	Maintain NCSP website to improve user interface and data retrievability		
	Operate and maintain a robust and secure infrastructure (e.g., web server hardware and software, NCERC "Red" network, etc.) to support information dissemination		
	Develop and maintain searchable criticality safety professional phonebook, include site/facility criticality safety point of contact (POC), include key words for experience/evaluation expertise		
	Implement a process to rapidly disseminate information (e.g., operational upsets, emergency response) to criticality safety professionals ("Crit spam")		
	Long term hardcopy archive of critical experiment logbooks, includes eventual electronic versions		
	Maintain and publish (as an electronic newsletter) a U.S./International database of near misses, operational issues and lessons learned (historical/future)		
	Provide periodic reports on NCSP Technical Program Review to communicate and promote to the criticality safety related community (web-published and ANS session)		
	Identify and retain key data important to criticality safety		
Partner with national and international entities for data collection, evaluation and preservation	Participate in national and international ICSBEP information exchange programs and meetings		
	Within ICSBEP, evaluate and review evaluations to assess the quality of available data to ensure data consistency and communication of discrepancies, publish unclassified and classified criticality safety-related benchmarks including historical/future sensitivity studies		

MISSION

The Integral Experiments (IE) program element sustains and enhances a fundamental nuclear materials handling capability to conduct subcritical, critical, supercritical, prompt critical, super-prompt critical, fundamental physics experiments, and training.

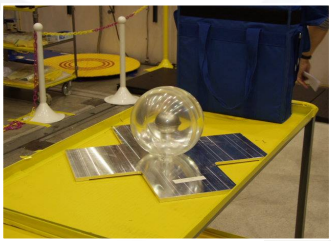
IE Vision

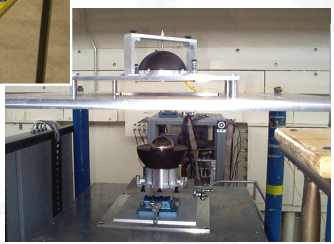
The IE element will serve as a national and international resource, providing a **sustainable** infrastructure including a systematic, interactive process to assess, design, perform, and document nuclear material experiments and training.

IE Strategy

The following strategy has been developed to direct the IE element towards achieving its vision. The IE element will:

- Provide and *sustain* integral subcritical, critical, supercritical, prompt critical, super-prompt critical, and fundamental physics experiments capabilities.
- *Sustain* a systematic and interactive process for identifying, assessing, and *continually improving* an *adaptable* integral experiment infrastructure, which incorporates personnel, programs, practices, technology, and facilities that provide the most *efficient* means of realizing the IE vision.
- *Sustain* a systematic and interactive process for identifying, assessing, and *continually improving* an *adaptable* integral experiment infrastructure, to users from other DOE elements and international partners of non-NCSP *operations*.





Example Critical Experiments

IE Technical Gap

Many of the previous 5-year goals were partially met and are ongoing. However, technical gaps remain in the Integral Experiments Program Element. Predominantly, these gaps are associated with: developing personnel as experimentalists and support personnel, maintaining and expanding facilities to support experiments, developing new experimental equipment, and identifying and acquiring nuclear and non-nuclear materials to support experiments. One goal was not met and will not be pursued further (k/α meter) due to unforeseen impracticalities. Other goals were not met and are being revised: Hot/Cold Machine shop, Rabbit system, Solution assembly, General-purpose horizontal split table, Radiochemistry/processing, Low-scatter facility, and Remote material handling capability.

IE Attributes and Goals

The IE program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
	Medium Priority
	Low Priority
	S T R E T C H

Integral Experiments - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel:		Budget Priority	
		Technical Priority	
Experimentalists	Develop/implement succession plans		
Equipment support personnel	Develop/implement succession plans		
Facility support personnel	Develop/implement succession plans		
Facilities:		Budget Priority	
		Technical Priority	
Support all Security Category Nuclear Material operations	Repair/maintain NCERC facility infrastructure to support IE mission		
	Develop SNL facilities as IE assets		
Support all nuclear material types and forms	Develop Authorization Basis to support powders and solutions		
Low-scatter facilities	Design and deploy low-scatter capabilities		
Machine shop Hot/Cold	Standup "cold" machine shop at NCERC		
	Standup "hot" machine shop at NCERC		
Support Free-Field experiments	Develop infrastructure to support free-field experiments		
Support Dynamic experiments	Develop infrastructure to support dynamic experiments		
Low-background counting area	Maintain Low-background counting area at NNSS		
Dosimetry laboratory	Design and deploy dosimetry laboratory at NNSS		
Radiochemistry laboratory	Design and deploy radiochemistry laboratory at NNSS		
Precision measurements laboratory	Install measurements laboratory at NCERC		

Integral Experiments - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Experiment equipment:		Budget Priority	
		Technical Priority	
General purpose vertical lift machine	Investigate vertical lift assembly for SNL		
Horizontal split table	Design horizontal split table		
Fast burst reactor	Investigate restoring SPR-III to service		
	Conceptual design of Np burst reactor		
Solution reactor	Investigate solution reactor design and location		
	Construct solution reactor		
Uranium lattice light water moderated (CX)	Maintain the SPRF/CX capability at SNL		
Fast benchmark assembly	Maintain GODIVA-IV operability at NNSS		
Rabbit system	Design and install Rabbit system at NCERC		
Materials:		Budget Priority	
		Technical Priority	
Nuclear - access to all nuclear material types and forms	Investigate acquisition of low-enriched metal (≤ 20% U)		
	Investigate acquisition of Np metal		
	Acquire Np metal		
Non-nuclear - access to all material types and forms	Maintain access to all non-nuclear material types and forms available with NCSP		
Process to manage experiments:		Budget Priority	
		Technical Priority	
Integral Experiment Request Process (identify experiment need, evaluate experiment need, design experiment, conduct experiment, document experiment)	Plan, perform, and evaluate experiments in accordance with $C_E dT$ process		
	Increase transparency of IER process		
	Adapt $C_E dT$ process for use with non-NCSP operations		
Training:		Budget Priority	
		Technical Priority	
Provide access to non-qualified personnel for training with all security category NM	Develop efficient process for access and escort of trainees at NCERC		

MISSION

The Nuclear Data (ND) program element includes the measurement, evaluation, testing, and publication of neutron cross-section data for nuclides of high importance to nuclear criticality safety analyses. The NCSP *continues* to *improve* coordination of nuclear data activities by fostering a strong *collaborative* effort among all of our national and international resources in this highly technical area. Examples of leveraging NCSP assets within the ND element through strong international *collaborations* include participation in OECD/NEA Working Party Evaluation Cooperation (WPEC) expert working groups, IRMM for differential measurements, and CEA for evaluations and validation testing. The objective is to solve the highest priority nuclear data problems relevant to criticality safety in a timely manner. This program element is essential for the NCSP because it provides the nuclear cross-section data required by the AM program element.

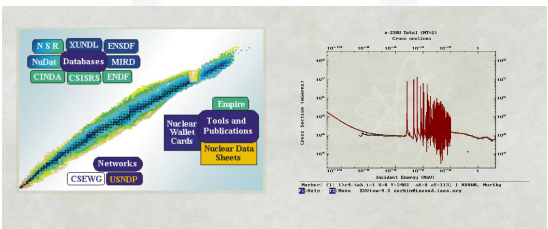
ND Vision

The ND element will **sustain** world-class **expertise** and capabilities to **continually improve** and disseminate measured and evaluated differential cross-section and covariance data in a manner that is **responsive** to the needs of those responsible for developing, implementing, and maintaining criticality safety.

ND Strategy

The following strategy has been developed to direct the ND element towards achieving its vision. The ND element will:

- Actively engage the criticality safety practitioners to identify their nuclear data needs through various means of *communication* and develop and disseminate evaluated nuclear data files to meet those needs.
- Produce world-class nuclear data evaluations of cross sections and covariances to address criticality safety data needs by developing and utilizing modern nuclear model codes with the best available experimental data.
- Assess, perform, analyze, and disseminate evaluated nuclear cross-section data to meet the needs of the criticality safety practitioners.
- Test, analyze, and document the performance of nuclear data measurements and evaluations to *continually improve* the nuclear data available for the criticality end-users.
- *Sustain* the NCSP nuclear data capabilities and *expertise* through *continual improvements* of the data files and mentoring of the next generation of leaders.



Evaluated Nuclear Data Files (ENDF/B)

ND Technical Gap

A large majority of the previous 5-year goals were partially met and are ongoing. It is recognized that most of these previous goals were dual in nature – perform priority measurements, evaluation and testing for the NCSP and to maintain capabilities in measurements, evaluation and testing. The dual value of maintaining these goals will not only be carried forward into the revised Mission and Vision but will also be made more explicit. Specifically, the new goals identify personnel, measurement facilities and capability to measure, model, evaluate and test new evaluations as resources that must be maintained. Two of the previous goals, which were not completed, related to procurement of samples and the automation of data validation. The only goal judged completed related to development of a national strategy for access and utilization of measurement facilities (which is documented in NDAG Tasking 2007-3).

Although significant progress has been made in the ND program element, additional work will be needed to improve nuclear data evaluations in the areas of thermal scattering, epi-thermal scattering, and fission measurement and analysis – thereby requiring improvements in measurement and evaluation capabilities. It may be noted that considerable progress has been made in evaluating covariance data for the ENDF/B files; however, there remains a large gap in these data, representing a priority data need that remains to be addressed. Furthermore, the existing ENDF/B data formats currently limit the representation of neutron reaction physics in the cross-section evaluations, and there is a pressing need to modernize and improve the ENDF/B formats to better represent nuclear reaction physics. As a result, the international nuclear data community has initiated efforts to develop a new, modern ENDF/B data format that will become the international standard format for future nuclear data evaluations, and investment in the ND and AM elements will be needed to ensure that the NCSP can *continue* to provide nuclear data libraries to address priority NCS nuclear data needs.

ND Attributes and Goals

The ND program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
	Medium Priority
	Low Priority
	S T R E T C H

Nuclear Data - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel:		Budget Priority Technical Priority	
Differential data experimentalists	Develop and implement succession plans to maintain thermal, resonance region, and above resonance region differential measurement expertise		
Nuclear model developers	Develop and implement succession plans to maintain nuclear data analysis methods expertise		
Nuclear data evaluators	Develop and implement succession plans to maintain thermal, resonance region, and above resonance region evaluation expertise		
Nuclear data testers	Develop and implement succession plans to maintain data validation expertise		
Differential measurements:		Budget Priority Technical Priority	
Access to and utilization of differential measurement facility(ies) and expertise	Develop 20-year plan for U.S. differential measurement capabilities and facilities needed to support NCSP measurement requirements		
	Develop and maintain existing U.S. capabilities to perform total, capture, and fission differential measurements		
	Establish collaboration agreements with domestic and/or international programs, agencies, and institutions as needed to ensure access to differential measurement capabilities		

Nuclear Data - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Differential measurements: (cont'd)		Budget Priority	
		Technical Priority	
Differential measurements of total, capture, fission, and scattering cross section data	Perform differential measurements on NCSP prioritized isotopes/nuclides		
	Disseminate and document measured results, uncertainties, and covariance data needed to support the cross-section evaluation effort		
	Identify and prioritize differential measurements beyond the next five years		
Differential measurements of thermal scattering law data for moderators	Develop new measurement capabilities for thermal moderators at various temperatures		
	Develop thermal data analysis capabilities needed to disseminate measured thermal data to evaluators		
	Perform differential measurements on NCSP prioritized moderators		
	Disseminate and document measured results, uncertainties, and covariance data needed to support the cross-section evaluation effort		
Models and calculations:		Budget Priority	
		Technical Priority	
Capability to evaluate experimental data	Maintain existing resonance analysis and nuclear model software to analyze differential measured data and produce nuclear data evaluations with covariance data		
	Develop and implement modernization plans for existing nuclear data analysis software (e.g., SAMMY, EMPIRE, GNASH, etc.)		
	Develop new evaluation capabilities to analyze measured thermal scattering data and produce thermal cross-section evaluations with covariance data		
	Develop new analysis tools to fully utilize new experimental capabilities such as the time projection chamber (TPC), Chi-Nu, and correlated data		

Nuclear Data - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Evaluations:		Budget Priority	
		Technical Priority	
Cross-section evaluations with covariance data for priority NCSP nuclear data needs	Complete cross-section evaluations including required reaction channels and energy ranges and covariance data on NCSP prioritized isotopes/nuclides per the NCSP Five-Year Plan		
	Disseminate and document completed cross-section evaluations as part of the current release of Evaluated Nuclear Data File (ENDF/B)		
	Identify and prioritize data evaluations beyond the next five years		
	Develop and deploy a new, modern ENDF/B evaluation format to replace the aging ENDF-6 format		
	Develop advanced graphical user-interface tools to facilitate dissemination, documentation, and understanding of evaluated cross-section data		
	Develop new evaluations with covariance data for fission product yields and delayed neutron data—will require re-establishing and sustaining expertise in this area		

Nuclear Data - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Data testing:		Budget Priority Technical Priority	
Accurate and reliable cross-section evaluations disseminated to the end-user	Utilization of tools of the AM element and benchmark data, (including the data of the ICSBEP element) to test the performance of new and existing cross-section evaluations		
	Report performance of evaluated data to nuclear data evaluator to improve quality of final nuclear data evaluations		
Quantify and prioritization of target differential data needs to guide nuclear data measurement and evaluation work	Develop S/U analysis capabilities needed to prioritize NCSP nuclear data needs and quantify target accuracies needed for differential measurement and evaluation tasks		
	Utilize S/U analysis capabilities to prioritize NCSP nuclear data needs and quantify target accuracies needed for differential measurement and evaluation tasks		

MISSION

The Training and Education (T&E) program element will *continue* to identify, develop, and facilitate training needs and educational resources (including hands-on training with fissionable material systems) in areas where no suitable alternative exists. The primary purpose of the T&E element is to maintain and enhance the technical abilities and knowledge of those who impact (Criticality Safety Engineers, Criticality Safety Officers, and managers) or are impacted directly by (operators and process supervisors) the practice of criticality safety. This includes training and education of people entering the criticality safety discipline from related scientific fields and maintaining and enhancing competency levels of those already in the community.

T&E Vision

The T&E element will identify, develop, provide, and promote practical and excellent technical training and educational resources that help ensure competency in the art, science, and implementation of nuclear criticality safety and is **adaptable** and **responsive** to the needs of those responsible for developing, implementing, and maintaining criticality safety.

T&E Strategy

The following strategy has been developed to direct the T&E element towards achieving its vision. The T&E element will:

- *Continually* evaluate qualification and knowledge expectations and *communicate* identified needs for training and education resources.
- Actively *communicate*, promote, and evaluate new and available training and education opportunities.
- Be *responsive* to identified training and education needs by developing and providing resources that *sustain* nuclear criticality safety capabilities and adequate oversight and awareness of criticality safety requirements.
- Provide *sustainable*, hands-on training in the behavior of fissionable material systems including those at or near critical conditions.
- Integrate training and education objectives through sharing of resources and *collaboration* with national and international partners.
- Develop *transparent* assessment processes to ensure competency for criticality safety engineers and/or criticality safety training programs consistent with ANSI/ANS 8.26 requirements and recommendations.

T&E Technical Gap

The T&E element has successfully utilized *expertise* throughout the DOE enterprise to establish and execute two individualized, *sustainable* training courses, for (1) on the floor process personnel and (2) managers, on nuclear criticality safety that combines classroom and fissile material processing facility instruction with hands-on instruction using criticality systems at experimental facilities. In addition, a joint program with the French CEA has enabled effective exchange of ideas and *expertise* on the conduct of experiments. Training on key computational analysis tools (MCNP, SCALE, and COG) *continues* to be provided by developers and experienced users. Training tutorials were completed on ICSBEP experiment evaluations, the ICSBEP experiment data base (DICE), human factors (embedded within the 2-week training course), and differential data and cross-sections while a tutorial on MC&A and its relationship to criticality safety was developed and jointly sponsored by the NCSP and the American Nuclear Society. Training on subcritical noise measurement methods and instrumentation for critical experimentation were accomplished under the IE Program Element and will be maintained under IE.

Goals that were not initiated or completed, but are still considered to be of interest to the NCS community, are carried forward as 5- or 10-year goals. These goals are:

- Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users,
- Tutorial on CAAS systems: placement evaluation needs and design options and consideration, and
- Tutorial on D&D related to criticality safety.

A few other T&E goals were not completed but were reassessed and modified as either a 5- or 10-year goal and included within the T&E Program Element or a sister Program Element. These goals are:

- Additional historical Pioneer videos (to IP&D and incorporated into a goal for creating operational experience interviews and training videos).
- Tutorial for managers, supervisors, criticality safety officers or criticality safety representatives, and DOE facility representatives (T&E goal modified to be a short course instead of being a tutorial).
- Module on the use of the criticality accident slide rule, NUREG/CR-6504, Vol. 2, “An Updated Nuclear Criticality Safety Slide Rule” (T&E goal modified to focus on support for emergency response activities).

A number of training goals related to specialized training in cross-section evaluation or processing (e.g., SAMMY, NJOY, PREPRO, and AMPX) were judged to be a component of sustaining subject matter experts and not relevant to general criticality safety practitioners and were modified and moved to the Nuclear Data Program Element. Some other T&E goals were simply deleted from the attribute/goal table based upon an assessment of the current need for the goal. The deleted goals typically include the development of training that had either already existed or were of low relative value to the NCS community.

T&E Technical Gap *(cont'd)*

There needs to be an expanded effort to identify or develop T&E resources that meet the needs of those that can impact the assurance of criticality safety or that might be impacted by criticality safety requirements. *Efficient* and effective training for on-the-floor process personnel are specific areas that need to be addressed. Providing improved methods and tools for evaluating training effectiveness will support ongoing enhancement of training and help ensure students are able to translate the learning experience to the workplace. Effective implementation of the T&E vision has meant a broadening of the mission and strategy to seek enhanced *collaboration* on identification, utilization, and assessment of existing T&E resources within the national and international community. The T&E element will also strive to assess competency expectations and suggest or implement tools and processes that will help ensure those competency expectations are maintained in individuals and/or programs.

T&E Attributes and Goals

The T&E program element will have the attributes and goals towards achieving its vision as shown in the tables to follow.

Budget and Technical priority rankings are based on the current and projected budgets and technical goals during the next 5 and 10 years. Color coding for the priority rankings in these tables is shown below.

Color Code	
	High Priority
	Medium Priority
	Low Priority
	S T R E T C H

Hands-On Training

Training and Education - Budget and Technical Priority Rankings

Attributes	Goals	5y	10y
Personnel/Facilities:		Budget Priority	
		Technical Priority	
Access to an integrated, coordinated, and consistent compendium of criticality safety training and education resources that provide effective training commensurate with need	A sustainable process to identify and communicate available training classes and education resources in the national and international communities		
	A gap analysis of training needs based on an assessment of available training and education resources in the national and international communities		
	An integrated compendium of training and education resources that is coordinated for consistency across US agencies and institutions and accessible to the criticality safety community		
	An integrated compendium of training and education resources coordinated with international partners to foster consistency on material and maximize use of unique resources		
	A sustainable process to obtain and incorporate feedback to expand or improve training course(s), training modules, or NCSET modules		
Collaborative environment between national and international communities	Cultivate and maintain university partnerships		
	Sustainable program (internship, rotational assignments, etc.) to facilitate collaborative training and education opportunities (national and international)		
	Collaborative training for experimenters in U.S. and foreign facilities		
Transparent qualification assessment tool for criticality safety engineers and/or criticality safety training programs	Evaluate recommendations from a multi-lab team and select a qualification program approach, complete with criteria, benefits, and required resources to ensure adequate implementation of the ANSI/ANS-8.26 standard		

Training and Education - Budget and Technical Priority Rankings (cont'd)

Attributes	Goals	5y	10y
Personnel/Facilities (cont'd):		Budget Priority	
		Technical Priority	
Transparent qualification assessment tool for criticality safety engineers and/or criticality safety training programs	Qualification guidance consistent with the ANSI/ANS-8.26 standard graded from entry level criticality safety engineers to requalification for experienced criticality safety engineers		
Provider of criticality safety training not readily available from other sources	The existing and unique training provided by the NCSP, e.g., classroom and hands-on experiment training, and NCSET modules, remains a high priority		
	A criticality simulator is available to demonstrate criticality physics fundamentals to process operators		
	A criticality simulator is available to simulate plant/process conditions and simulate a walk-through, i.e., simulated facility could be staffed by role players (e.g., operators)		
	A mobile (CAT III or IV material) criticality hands-on critical or near critical demonstration capability is available		
	Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users		
	Tutorials on CAAS system placement evaluation needs and design options and considerations		
	Tutorial on D&D related to criticality safety		
	Sustain a training course for managers, supervisors, criticality safety officers, or criticality safety representatives, and DOE facility representatives		
	Develop an NCSET module on the use of criticality safety accident slide rule to support emergency response		
	Develop a mobile CAT 1 criticality hands-on critical or near critical demonstration capability		

Tabulation of the Goals and Attributes of NCSP Technical Program Elements for the *First* Mission and Vision document

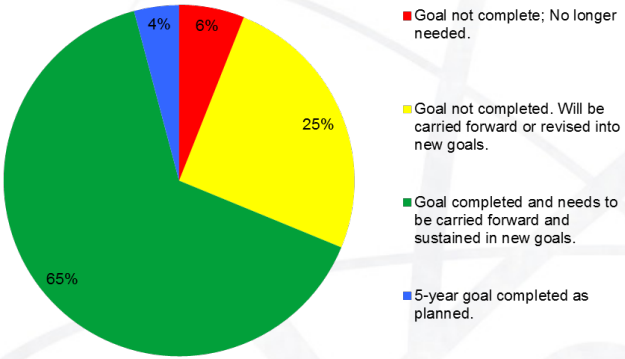
FY 2008 – FY 2013

Please note that this original Appendix A section is being preserved in this document for archival and future out-year comparison purposes. New Goals and Attributes tables are provided in the main body of this document within each program element.

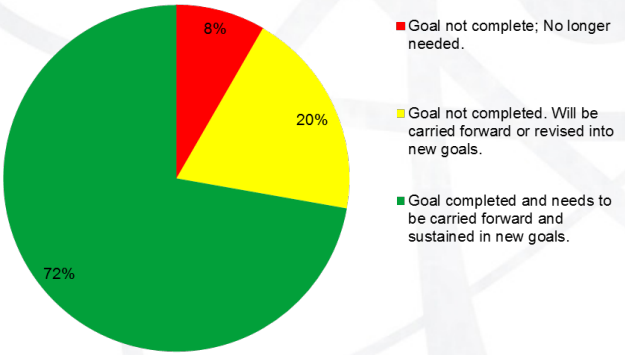
(The parenthetical text here is being preserved from the FY 2008-2013 NCSP Mission Vision document: "The following tables summarize the goals and attributes of each of the NCSP program elements as envisioned in the five- and ten-year periods. A check mark in the "5-Year" column indicates that the item or sub-item is part of the Five-Year Plan, and a check mark in the "10-Year" column indicates that it is part of the longer-term plan. In many cases, five-year items are carried over to the ten-year scope.")

The *revised* Mission and Vision document for FY 2014-2023 is organized differently from the last document in that each program element section flows from Mission; Vision; Attributes of a Robust Program Element; to Five Year, Ten Year, and Stretch Goals that if met will help sustain the attributes of a robust program. Furthermore, the ***NEW*** Attributes and Goals tables *(now incorporated into the main body of this document within each program element)* are color coded to depict a consensus of technical and budget priorities. As before, future, revised versions of this document will *continue* to provide the foundation for the NCSP Five-Year planning process.

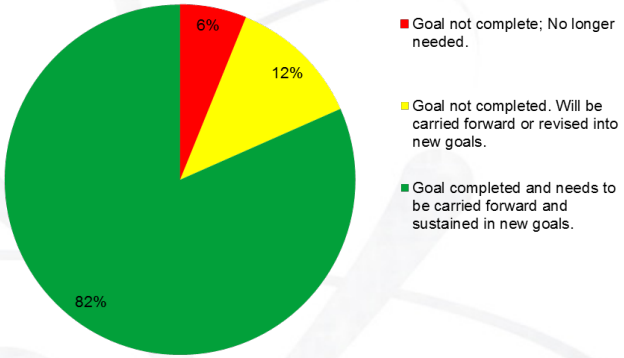
The NCSP performance for the previous 5-Year goals have been assessed as part of the 2013 Mission Vision revision effort, and an assessment of completion is provided in Appendix A.



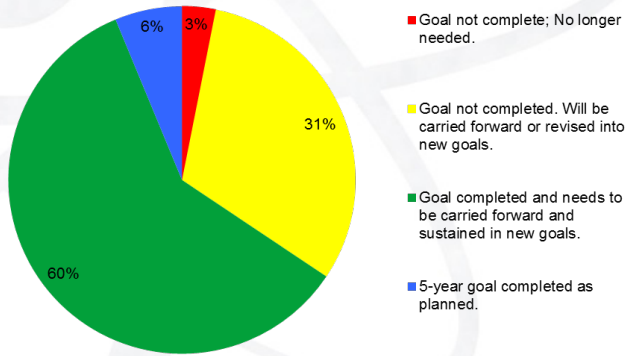
NCSP Mission & Vision FY2009-2018
Goals Mid-Term Assessment



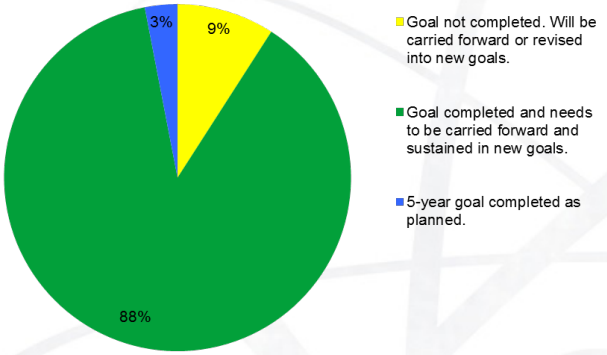
Analytical Methods
Goals Mid-Term Assessment



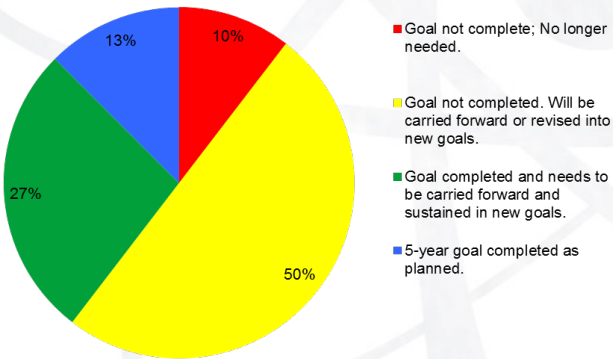
Information Preservation & Dissemination Goals Mid-Term Assessment



Integral Experiments Goals Mid-Term Assessment



Nuclear Data
Goals Mid-Term Assessment



Training & Education
Goals Mid-Term Assessment

Table A.1. Analytical Methods 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
Perform analyses for criticality safety evaluations o Normal o Upset	√	√
Perform sensitivity/uncertainty analyses o Range of applicability o Adjusted libraries ▪ *posteriori* group constants ▪ *posteriori* C/E values and uncertainties	√	√
Design experiments o Critical o Subcritical	√	√
Analyze benchmarks o Critical o Subcritical	√	√
Develop approaches and tools for analysis of accidents o Real time response capabilities o Kinetics o Multiphysics	√	√
Analyze Shielding and CAAS coverage	√	√
Analyze burnup/depletion	√	√
Participate in C_EdT process	√	√
Analyze accidents o Real-time response capabilities o Kinetics o Multiphysics		√
Attributes	**5y**	**10y**
Processing codes and data libraries		
o Input evaluations in all "standard" formats from international compilations	√	√
o Reaction cross section/energy/angle	√	√
o Covariances (reaction/energy/angle) ▪ Developing methodology for angle-dependent covariances		
o Covariances (reaction/energy/angle)	√	√
o Create code dependent libraries ▪ Continuous-energy ▪ Multigroup	√	√
o Software Quality Assurance of processing codes and libraries	√	√
o Computational ▪ Platforms ▪ Operating systems, compilers ▪ Adaptable, sustainable (languages, etc.)	√	√
Radiation transport codes		
o Solution method ▪ Monte Carlo	√	√
▪ Deterministic	√	√
▪ Developing plans for Coupled Monte Carlo-Deterministic	√	
▪ Coupled Monte Carlo-Deterministic		√

Table A.1 (cont'd). Analytical Methods 5- and 10-Year Goals and Attributes

Attributes (cont'd)	5y	10y
Radiation transport codes (continued)		
○ Geometry		
▪ 1D → generalized 3D	√	√
▪ Developing plans for Computer Aided Design (CAD) interface	√	
▪ CAD interface		√
○ Physics		
▪ Coupled neutron, photon		
▪ Eigenvalue/fixed source		
▪ Forward and adjoint		
▪ Time-dependent	√	√
▪ Continuous-energy		
▪ Fine group, problem-dependent multigroup		
▪ Subcritical techniques		
▪ Depletion capability		
○ Ease of Use		
▪ Documentation, including online help		
▪ Graphical User Interface	√	√
▪ Interoperability		
▪ Materials preprocessing		
○ Output, analyses, linkages		
▪ Develop plans to link to other physics codes	√	
▪ Ability to link to other physics codes		√
▪ Detailed physics edits, including detectors	√	√
▪ HTML+	√	√
▪ Graphical displays	√	√
▪ Flux, reaction rate edits for burnup analysis	√	√
○ Software quality assurance of transport codes	√	√
○ Computational		
▪ Platforms (including parallel)		
▪ Solution Efficiency (variance reduction, source convergence, etc.)	√	√
▪ Operating Systems, compilers		
▪ Adaptable, sustainable (languages, etc.)		
Sensitivity/uncertainty methods		
○ Sensitivity analysis		
▪ Sensitivity profiles	√	√
▪ Similarity		
▪ Uncertainty propagation		
○ Data adjustment	√	√
○ Software quality assurance of sensitivity/uncertainty codes	√	√
Tools		
○ Develop plans for automated tasks to support		
▪ Criticality safety engineer evaluation	√	
▪ Data validation		
▪ Data adjustment		
○ Automated tasks to support:		
▪ Criticality safety evaluations		√
▪ Data validation		
▪ Data adjustment		
○ Slide rule+	√	√
○ ARH-600 (move under sub-tasks in IP&D)	√	
○ Electronic ARH-600 (move under sub-tasks in IP&D)		√

Table A.2. Information Preservation and Dissemination 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
Implement data calls for available material	√	
Provide processes for evaluating available material for IP&D value	√	
Develop a repository for all evaluations/reports associated with criticality safety from this point forward	√	
Archive and disseminate training and operational videos (historical and current)	√	
Develop and maintain a searchable registry of nuclear criticality safety personnel with areas of expertise	√	
Preserve unclassified topical (waste drums, vault storage, onsite and offsite transport, criticality alarm placement, D&D, etc.) references	√	
Distribute approved criticality safety program description documents	√	
Develop local electronic searchable archive of criticality safety evaluations and experimental logbooks (with bibliographic listings made available to DOE and contractors)		√
Develop a process for keeping the Criticality Safety Coordinating Team informed about emerging regulatory actions, impacts and initiatives (DOE letters to contractors)	√	
Implement a process to rapidly disseminate information to all DOE criticality safety practitioners (“Crit spam”)	√	
Maintain a U.S. Compendium of near misses and lessons learned from them (historical)	√	
Maintain an International Compendium of near misses and lessons learned from them (historical)		√
Provide periodic reports on NCSP accomplishments to communicate and promote to the criticality safety related community (published, ANS session)	√	√
Attributes	**5y**	**10y**
Online card catalogue technology	√	√
Partnership with other organizations (ANS, Nuclear Science and Engineering, other journals) for article retrieval	√	√
Easily accessible	√	√
Web-based	√	√
Single data source with access to all data	√	√

Table A.3. Integral Experiments 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
Fully functional C_EdT process		
o Identifies integral experiment needs		
o Evaluates and assess experiment needs		
o Develops, evaluates, and modifies (as necessary) conceptual and final experimental designs	√	√
o Conducts integral experiments		
o Formally documents experiment results		
Fully staffed Critical Experiments Facility with succession planning	√	√
Infrastructure required to support CEF operations (outside scope of NCSP)		
o Administration		
o Security Category I/Hazard Category II nuclear operations, including critical operations	√	√
Fully functional CEF		
o Fast burst assembly	√	√
o Two general-purpose vertical assembly machines	√	√
o Fast benchmark assembly	√	√
o Two general-purpose measurement laboratories	√	√
o Access to a wide variety of nuclear material and materials required for nuclear experiments (e.g., structural materials, reflector and interstitial materials, test materials)	√	√
o Fissionable material storage vaults	√	√
o Machine shop	√	√
o Counting room	√	√
o Rabbit system (rapid sample handling)	√	√
o Operator, education, training, and qualification programs	√	√
New project development		
o Solution assembly	√	√
o General-purpose horizontal split table	√	√
o Radiochemistry/processing	√	√
o Conceptual development		
▪ k-, α-meter	√	√
▪ Tomographic imaging of fluxes	√	√
▪ Fundamental physics measurements	√	√
o Low scatter facility	√	√
o Remote material handling capability	√	√
o Security posture capable of supporting work with uncleared personnel and foreign nationals (U.S. facilities)	√	√
Solution assembly		√
General-purpose horizontal split table assembly		√
Low scatter facility		√
Radiochemical laboratory		√
Solution handing/mixing/purification/storage		√
Security posture capable of supporting classified activities, and activities with uncleared personnel and foreign nationals (for U.S. facilities)		√

Table A.3 (cont'd). Integral Experiments 5- and 10-Year Goals and Attributes

Attributes	5y	10y
Research and development		
o k-, α-meter		√
o Tomographic imaging of fluxes		√
o Fundamental physics measurements	√	√
Conduct of classified experiments	√	√
Design, analyze, and conduct subcritical experiments		
o Radiation test object construction	√	√
o Neutron driven noise analysis	√	√
o Rossi-alpha	√	√
o Feynman variance-to-mean	√	√
o Oscillator	√	√
o Pulsed die-away	√	√
o Source-jerk	√	√
o Inverse multiplication	√	√
o Low scatter facility		√
Design, analyze, and conduct critical experiments		
o Fast burst metal (uranium)	√	√
o Solution burst		√
o Fast benchmark	√	√
o General purpose vertical	√	√
o General purpose horizontal		√
o Solutions/lattices (uranium, plutonium)		√
General radiation measurements o Spectral ratios o Flux mapping o Criticality alarm o Shielding/transmission	√	√
Radiochemistry		√
Nuclear materials handling capabilities		
o Manual	√	√
o Remote		√
General nuclear criticality safety experimental measurement training		
o Uncleared U.S. personnel	√	
o Uncleared personnel		√
o Training and collaboration with foreign nationals	√	√
o Critical Experiments Facility operators	√	√
General infrastructure o Machine shop with the ability to work with contaminated materials	√	√

Table A.4. ICSBEP 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
A sustainable infrastructure o Program management, integration and coordination with NCSP elements and other programs, and international collaboration o Qualified technical and support staff o Utilization of international expertise		√
Participation in national and international information exchange programs and meetings in which ICSBEP participants focus on identification of data needs and available resources	√	√
Participation in the C_EdT process	√	√
A rigorous evaluation and review process that will evaluate and assess the quality of available data	√	√
Assessment methods and data consistency and communicating discrepancies	√	√
Evaluate and publish open and classified criticality safety-related benchmarks o Evaluation o Classification reviews o Independent and technical working group review o Publication management ▪ Graphic arts ▪ Technical editing ▪ Production of current publication media	√	√
Improved benchmark characterization	√	√

Table A.4 (cont'd). ICSBEP 5- and 10-Year Goals and Attributes

Attributes	5y	10y
A primary program focus on o Both existing and new critical and subcritical experiments o Criticality-alarm/shielding measurements o Relevant criticality safety-related fundamental physics measurements	√	
A primary program focus on o Newly measured experiments o Existing criticality-alarm/shielding measurements o Existing fundamental physics measurements		√
Periodic reassessment of the criteria for performing, reviewing, and approving ICSBEP evaluations	√	√
Periodic ICSBEP technical review meetings	√	√
Periodic publication of the *International Handbook of Evaluated Criticality Safety Benchmark Experiments* (ICSBEP Handbook) in its entirety using current media	√	√
Continual improvement in the sustainability and usability of the ICSBEP Handbook	√	√
Solicitation and response to user and evaluator needs and feedback	√	√
Periodic review, assessment, and improvement in current data characterization methods	√	√
Implementation of a formal review and comment/feedback mechanism as a means for continual improvement	√	√
Enlistment of next-generation experts in the evaluation process, technical review meetings, and publication of their work	√	√
Informing program managers and educators about technical benefits of participation	√	√
Program to systematically verify input	√	√
Verified code input descriptions	√	√

Table A.5. Nuclear Data 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

Goals	5y	10y
Measured cross-section data o Thermal, resonance, fast o Total and capture measurements for stable nuclides, o Defined approaches to measure fission, scattering, gamma-production, multiplicity, double differential cross sections in energy and angle, prompt and delayed data o Cross-section data published and archived in formalized database	√	
Calculated, evaluated, and performance tested cross-section data		
o Thermal, resonance, fast	√	√
o Total, fission, capture, scattering, gamma-production	√	√
o Multiplicity	√	√
o Double-differential cross sections in energy and angle	√	√
o Covariance data	√	
o Prompt and delayed	√	√
o Defined approaches to obtain and use correlated data	√	√
o Cross-section data published and archived in formalized database	√	√
o Correlated data		√
Automated data validation incorporating the breadth of ICSBEP benchmark data, developed sensitivity/uncertainty tools, cross-sections and covariance data and integral data to reduce predicted uncertainties in a rigorous defensible method which identifies and quantifies true data needs	√	

Table A.5 (cont'd). Nuclear Data 5- and 10-Year Goals and Attributes

Attributes	5y	10y
Differential Measurements		
○ Develop plan for procurement of long lead-time samples	√	
○ Sample procurement		√
○ Develop national strategy for access to and utilization of differential measurement facility(ies) and perform NCSP priority measurements	√	
○ Access to and utilization of differential measurement facility(ies)		√
○ Differential measurements focused on total and capture cross sections of stable nuclides while implementing a plan to include fission, scattering, etc. ▪ Experimental techniques and design to meet target accuracies ▪ Experimental apparatus including detectors, fission and scattering chambers, data acquisition, etc. to meet target accuracies ▪ Data reduction/analysis of measured data ▪ Dissemination/documentation of measured results	√	
○ Differential measurements of total, capture, fission, scattering, etc. cross sections ▪ Experimental techniques and design to meet target accuracies ▪ Experimental apparatus including detectors, fission and scattering chambers, data acquisition, etc. to meet target accuracies ▪ Data reduction/analysis of measured data ▪ Dissemination/documentation of measured results		√
Models and Calculations		
○ Analysis tools to evaluate experimental data	√	√
○ Accuracy of nuclear model calculations to extend cross-section data to include required reaction channels and energy ranges is improving toward target accuracies	√	
○ Nuclear model calculations to extend cross-section data to include required reaction channels and energy ranges		√
Evaluations		
○ Complete cross-section evaluations including required reaction channels and energy ranges and covariance data	√	√
○ Dissemination/documentation of evaluated data	√	√
Data Testing		
○ Utilization of tools of the AM element and benchmark data, including the data of the ICSBEP element	√	√
○ Report performance results of evaluated data	√	√

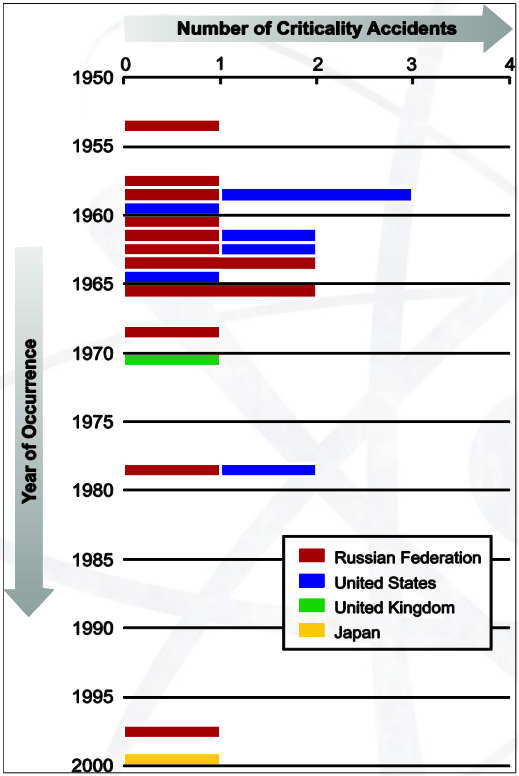
Table A.6. Training and Education 5- and 10-Year Goals and Attributes

Color Code	
	Goal not complete; No longer needed.
	Goal not completed. Will be carried forward or revised into new goals.
	Goal completed and needs to be carried forward and sustained in new goals.
	5-year goal completed as planned.

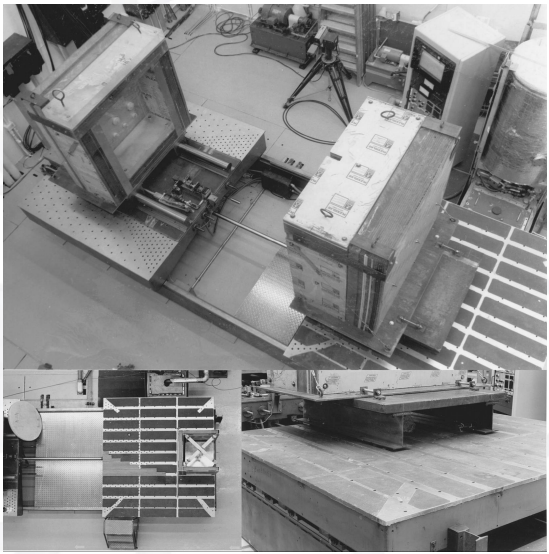
Goals	5y	10y
ICSBEP		
o Handbook/DICE training	√	√
o Tutorial on ICSBEP evaluations	√	√
o Tutorial on uncertainties/statistics	√	√
Nuclear Data		
o Tutorial on development of differential data and cross sections (experimental) for end-users	√	
o Multiplicity and NuBar interpretation and methods		√
Analytical Methods		
o MCNP training	√	√
o SCALE training	√	√
o Sammy training	√	√
o NJOY training	√	√
o Covariance and uncertainty training	√	√
o AMPX training		√
o PREPRO training		√
o COG training		√
o Tutorial on development of differential data and cross sections for the end-user		√
Integral Experiments		
o Hands-on training on critical systems	√	√
o Collaborative training for experimenters in U.S. and foreign facilities	√	√
o Educational opportunities for non-experimenters at experimental facilities	√	√
o Tutorial on subcritical noise measurement methods	√	
o Tutorial on instrumentation for critical experimentation		√
o Hands-on training involving Security Category III/IV quantities		√

Table A.6 (cont'd). Training and Education 5- and 10-Year Goals and Attributes

Goals (cont'd)	5y	10y
Other		
o Tutorial on subcritical methods and benchmark interpretation for nuclear criticality safety users	√	
o Tutorial on MC&A and its relationship to criticality safety including nondestructive assay	√	
o Tutorial on human factors related to criticality safety	√	
o Tutorial on formal methods for criticality hazards analysis	√	
o Plutonium chemistry/uranium chemistry/material properties	√	
o Additional historical Pioneer videos	√	
o Tutorial on CAAS system designs		√
o Tutorial on CAAS placement evaluation (accident yields, transmission, standards)		√
o Tutorial on D&D related to criticality safety		√
o Destructive analysis tutorial		√
o Tutorial for managers, supervisors, criticality safety officers or criticality safety representatives, and DOE facility representatives		√
o Module on use of criticality accident slide rule		√
Attributes	**5y**	**10y**
Develop a process to allow the end-user community to identify needed training	√	
Interactive multimedia training capability	√	
Transferable cards/certificates of accomplishment from DOE for criticality engineers	√	
University partnerships	√	
Find, tailor, and adapt and make generally available training that exists at DOE sites	√	
Online university classes	√	
Survey of best contractor training practices	√	
Simulation environment for training		√
SimCity with process control and limits to "run your own electronic process"		√
DOE NCSP scholar/intern program/rotation program		√
The single center of excellence for criticality safety training that provides for tailored training commensurate with need o Criticality simulator o Ability to do hands-on material experimentation o Ability to handle cleared/uncleared o Staffed by experts with specific knowledge basis o Ability to simulate plant/process conditions and simulate walking them down (i.e., simulated facility should be staffed by role players [e.g., operators]).		√
IP&D training o Lessons learned from criticality accident near misses		√



Chronology of Process Plant Criticality Accidents



Horizontal Split Table Critical Assembly Device

Critical Mass Laboratory Control Panel

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